Electronic Version

Stylesheet Version v1.1.1

Claims

[c1] A photonic integrated circuit (PIC) for demultiplexing a multiplexed optical signal in to its constituent wavelengths and for combining n input optical signals composed of n different wavelengths in to a multiplexed signal. The said PIC is composed of:

a plurality of input/output waveguides for inputting signal to and outputting signal from the PIC;

a slab waveguide for coupling the input signal to the array of waveguides and for focusing the demultiplexed signals to the output waveguides;

an array waveguide, containing plurality of waveguides which are optically coupled on the slab plane at one end, and terminated by a reflecting mirror on the other end, having a fixed path difference between neighboring waveguides, for coupling the input signal and then separate the same into constituent wavelengths and then focusing the individual wavelengths back on to the slab-input/output waveguide interface;

a reflective mirror terminating the said array of waveguide for reflecting the signals incident on it from the array waveguide back into the array; and

a substrate on which the input/output waveguides, the slab, and the array of waveguides are fabricated by a layer by layer approach. The assembly forms a photonic integrated circuit or an optical chip, termed as a reflective arrayed waveguide grating (RAWG).

[c2] The RAWG of claim 1 wherein a single slab waveguide is provided that functions as both input and output slab; and wherein a single external interface functions as both input and output allowing significant packaging reliability enhancement of the device.

[c3] The RAWG of claim 1 wherein the design architecture reduces the chip size to approximately 50% of that required for a TAWG of identical channel number; and wherein the on-chip loss is reduced significantly compared to a TAWG of same number of channels and both made from the same material.

[c4] The RAWG of claim 1 wherein the reduced chip size almost doubles the RAWG yield per wafer compared to a TAWG having the same number of channels as RAWG; and wherein the higher yield in turn lowers the production cost of the devices while simultaneously enhances performance; and further wherein a smaller chip size will result in more compact package size.

[c5] The RAWG of claim 1 wherein the design allows significantly lower on-chip loss.

[c6] The RAWG of claim 1 wherein any one of the waveguides can be used as the input channel while the remainder waveguides will function as the output channels allowing a built-in vernier effect, because, any of the waveguides can be used to launch the input signal while the rest will automatically be the outputs; and wherein the RAWG allows to choose output wavelengths by choosing an appropriate input waveguide, while for a fixed input channel, the output wavelengths are always fixed.

[c7] The RAWG of claim 1 wherein there is plurality of channel numbers that can be varied as 4, 8, 12, 16, 24, 32, and 48; wherein channel spacing can be varied to comply with ITU-T definitions such as 0.25 nm (~31 GHz), 0.4 nm (50 GHz), 0.8 nm (100 GHz), 1.6 nm (200 GHz), 4 nm (500 GHz), and 5 nm (624 GHz); and wherein the channel frequencies can be designed to match the ITU grid frequencies.

[c8] A method of integrating a photonic integrated circuit (PIC) by monolithic integration over three tiers, termed triple-phase integration; wherein a RAWG such as the one in claim 1 used as a building block for further functionality enhancement; wherein a second-phase integra-

tion of the said RAWG in claim 1 produces passive devices with amplification; and wherein a third-phase integration of the said RAWG in claim 1 produces active devices with amplification.

[c9] A method of second-phase integration of the photonic integrated circuit (PIC) as in claim 7; wherein a RAWG for demultiplexing a multiplexed optical signal in to its constituent wavelengths and for combining n input optical signals composed of n different wavelengths in to a multiplexed signal; and for amplifying the said multiplexed and demultiplexed signals; the said PIC is composed of:

a RAWG as in claim 1;

a waveguide amplifier block;

the RAWG and the amplifier block are connected via waveguide interconnect;

a substrate housing the RAWG, the amplifier block, and the waveguide interconnects that are fabricated by a monolithic means such as a layer by layer approach. The assembly forms a second-phase photonic integrated circuit, termed as an amplified PIC (APIC).

[c10] A method of third-phase integration of the photonic integrated circuit (PIC) as in claim 7; wherein a RAWG for demultiplexing a multiplexed optical signal in to its constituent wavelengths and for combining n input optical

signals composed of n different wavelengths in to a multiplexed signal; for modulation of the said optical signal; and for amplifying the said optical signal; the said PIC is composed of:

a modulator block composed of waveguides and electrodes;

a RAWG as in claim 1;

a waveguide amplifier block;

the modulator, the RAWG and the amplifier block are connected via waveguide interconnect;

a substrate housing the modulator block, the RAWG, the amplifier block, and the waveguide interconnects that are fabricated by a monolithic means such as a layer by layer approach. The assembly forms a third-phase photonic integrated circuit, termed an amplified electronic PIC (AEPIC).